California Cancer Commission Studies*

Chapter XXIX

Tumors of the Brain and Spinal Cord

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IF a brain tumor is suspected, the diagnostic aids to prove or disprove its presence are numerous. Thirty years ago they were unknown. These are pneumoencephalography, electroencephalography, and arteriography. By one or the other, and not infrequently by information from all three, the site of the neoplasm can be determined, and the pathologic structure and size of the lesion as well. All of this has contributed to an early identification and given assurance in the selection of the surgical approach and the method of treatment.

The responsibility for suspecting a tumor in its early stages rests upon the physician who is consulted first. Under what conditions, then, should one suspect a neoplasm? Obviously not when one is confronted with fever and evidence of infection, and not when there are clear indications of more than one localization, such as signs pointing to both hemispheres or to several areas in the nervous system.

When the signs or symptoms can be explained on the basis of a single lesion *which is progressing,* one should think of tumor. The rate of onset gives a clue. An embolic lesion appears instantaneously, a hemorrhage occurs in a matter of minutes, a thrombosis usually over hours. Tumors give indications of their presence over weeks or months. A progressive single lesion implies growth, and adequate diagnostic methods are required. One should not delay for the appearance of signs and symptoms indicative of its space-consuming ("chorophagic") nature, such as choked disks, headaches, vomiting, or other evidences of advanced intracranial pressure. In the late stages, the individual harboring a tumor presents evidence of a single, progressive and chorophagic lesion.

The presenting symptoms may be varied. Contrary to the prevailing impression, chronic, constant headaches are not indicative of tumor. Adults who, without previous head injury or syphilis, develop *fits* are suspect. *Progressive paralysis, aphasia or dysphasia, complaints referable to ear or eye with increasing loss of function,* all demand investigation. Too often, in the absence of neurological findings, complaints combined with some *changes in temperament* cause the patient to be referred to the psychiatrist, and the true nature of the trouble is unrecognized. *Vomiting* as a primary symptom is not infrequently seen in children with posterior fossa tumors, and may antedate the appearance of other signs by weeks or months so that psychogenic cause may be suspected. In the cerebral tumors of adults, vomiting is not a prominent symptom.

The neurological findings on clinical examination, together with plain x-ray films, are usually sufficient to diagnose a tumor. The diagnostic aids employed by the neurological surgeon are required for more accurate localization so that the procedure selected for removal will involve the most direct approach with minimum tissue resection. They also give additional information useful in forecasting the type of tumor, the variety of neoplasm, or the presence of an aneurysm.

Some generalities may be permitted. Subtentorial tumors predominate in childhood; viz., the midline medulloblastomas originating in the roof of the fourth ventricle, the astrocytomas unilateral in origin, and the less frequent ependymomas. The craniopharyngiomas (Rathke pouch tumors) in most instances give evidence of their presence in childhood.

Supratentorial tumors predominate in adults, particularly in middle age, and are more common in the anterior and middle portions of the hemispheres than posteriorly. The origin of the meningiomas is indicated by their name. In this sense they are not truly brain tumors. They grow over a period of years, rarely become sarcomatous, but may invade or penetrate bone in advanced stages. Ordinarily they are encapsulated, benign, and do not recur if removed with the invaded dura. They are rare in the young and reach the peak of their frequency in adults around the age of 45. It is in persons in this age period, too, that the acoustic neurinomas are observed. These posterior fossa tumors progress over years, giving rise to tinnitus with progressive deafness and nystagmus long before intracranial pressure and cerebellar signs appear. In the cerebral hemispheres, chiefly in adults, are seen the slowly growing, relatively benign gliomas—the astrocytomas and oligodendrogliomas—which repay radical removal with long periods of life and even cure.

The *bête noir* of the brain surgeon is the glioblastoma multiforme. Highly malignant, rapid in growth, often involving motor or speech areas, occurring in the most active period of middle age, relatively insensitive to x-ray, it recurs within weeks or a few months after even the most radical removal.

There are four types of pituitary adenomas. The chromophobe adenomas, most common of all, occur in middle age, and failure of vision or field defects bring them to the attention of the physician. It may then develop that the patient, if a woman, has con-

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sulted the gynecologist because of amenorrhea, or if a man, because of impotence. The eosinophilic adenomas are usually recognized because of the action of the acidophilic cells, which secrete growth hormone and produce gigantism or acromegaly or both. The basophilic adenomas are suspect in "Cushing's disease" but they present clinical pictures indistinguishable from certain primary adrenal growths. The malignant pituitary adenomas are so called largely because they have burst their capsular confines.

Metastatic tumors to the brain from distant primary sources constitute perhaps 3 per cent of brain tumors, and frequently attract attention before the primary tumor is evident. The lung, breast, and melanotic growths are likely sites of origin. The bowel and adrenal gland are less commonly the sites of origin.

Primary intracranial tumors have a distinctive way of spreading, not through the blood stream or lymphatics, but by seeding and sowing implants along the pathways of the cerebrospinal fluid. By this process it is common in the medulloblastomas of children to have the late development of a paraplegia from a separate implant in the spinal canal. Such a spread is less often seen with glioblastomas and ependymomas, and rarely with astrocytomas. In countries where echinococcus infestation is common, multiple space-consuming lesions have this special implication.

By roentgenographic study, even without the special techniques of air injection or arteriography, additional diagnostic information is readily obtained. The films may show the results of increased pressure; namely, the separated sutures (readily anticipated by a cracked-pot note on percussion of the skull), or the beaten silver appearance. The former occurs in younger children and the latter seldom is seen in patients beyond the middle of the third decade. The pineal, if calcified, may be shifted away from the hemisphere of greater volume and higher pressure. An enlarged sella turcica may indicate a hypophyseal adenoma, a flattened or enlarged one point to a Rathke pouch tumor with its spotty calcification. A spread and enlarged sella should always, however, bring to mind the possibility that one is dealing with a large third ventricle with hydrocephalus. Localized bone changes—thickening, rarefaction and destruction—are all seen at various stages with meningiomas. Metastatic tumors, epidermoids, and myelomas are accompanied by fairly characteristic bone changes. Certain tumors are prone to show calcifications. The Rathke pouch tumors have been mentioned as one variety, but a high percentage of the oligodendrogliomas do also, and a considerable number of astrocytomas and aneurysms. In other lesions calcification is less frequent.

Successful surgical treatment of intracranial tumors is dependent upon their accessibility, their type, and the stage at which they are diagnosed. The outcome is determined by the extent of involvement of important areas (motor, speech, etc.). Approximately 55 per cent of all intracranial tumors fall within the favorable, i.e., removable group, granting that a reasonably early diagnosis is made and that surgical treatment is properly executed. Improved anesthesia, the electrosurgical unit, the newer hemostatics, and the antibiotics, have supplemented the diagnostic aids mentioned above. As a result, tumors formerly unapproachable, or removable only in part, can now be eradicated. With these advances also, the operative mortality for intracranial new growths varies between 10 and 15 per cent.

Neoplasms of the Spinal Cord

Twenty-five years ago a survey of the cord tumors treated at the University of California Hospital revealed that each patient consulted on an average of 18 physicians before a diagnosis was made. Today the situation is vastly different, and the diagnosis is usually suspected before an advanced stage of paralysis is reached.

The *bilaterality of sensory, motor or reflex changes,* in the lower extremities alone, or in all four extremities, indicates the likelihood that the site of trouble is in the spinal canal. The progressive feature suggests a growth. A partial or complete blockage of the canal shown by spinal puncture and the Queckenstedt test confirms the physical characteristic of the lesion.

A constant radiation of radicular pain, usually worse at night, may indicate tumor long before other signs appear. Such a complaint merits a spinal puncture, Queckenstedt test, estimation of the spinal fluid proteins, and x-ray study. With the establishment of a definite level of sensory alteration and gradually developing disability below it, a growth should be diagnosed.

Fifty per cent of primary cord tumors are encapsulated, benign meningeal tumors or neurofibromas. The latter may be multiple in von Recklinghausen's disease. With such extramedullary tumors the sensory changes, although not necessarily uniform, are more pronounced in the distal parts of the extremities. Involvement of the sphincters is a late manifestation. Pain, not usually intense, is greater than with the intramedullary growths. The latter are apt to be ependymomas, other types of gliomas, or epidermoids. Sensory changes may, with laterally placed tumors, be of Brown-Sequard type. The intramedullary tumors produce the most marked sensory changes in the segments corresponding to their extent in the cord, rather than in the distal parts of the extremities. Tumors in the lumbar canal, because of involvement of the cauda equina rather than of the spinal cord, are associated with decreased reflexes in contrast to the increased reflexes characteristic of cord lesions. They should always be suspected when bilateral sciatica is present. These tumors, because of the ready displacement of the cauda, may attain huge size before neurological signs appear.

Variations in the neurological picture caused by cord compression are as numerous as the possible locations of the lesion from sacrum to foramen magnum. When compression of the cord is suspected, spinal puncture and the studies mentioned above should be performed. When further details of the level of the lesion are required, fluoroscopic study with x-ray pictures may be obtained by the introduction of radiopaque material into the spinal canal. Pantopaque is at present the most satisfactory material used for this purpose and may be aspirated and removed under the fluoroscope at the conclusion of the study.

Bone disease which causes cord compression may be demonstrated by plain x-ray films. Primary bone growths, such as giant cell tumors, and metastatic lesions, from the prostate or other sources, are not uncommon. The granulomas, particularly tuberculomas and their associated extradural abscesses, may be shown. Because of the common extension of extradural tumors through the intervertebral foramina, giving rise to the shape known as dumb-bell or hour-glass, complete x-ray studies should include three-quarter views as well as anteroposterior and lateral pictures. These may show enlarged foramina. Widening of the spinal canal by enlarging tumors may be demonstrated.

The extradural tumors include growths of blood vessel origin, occasional lipomas, chondromas, and some of neurogenic origin. These are frequently of the hour-glass type.

Surgical removal of the benign, intradural but extramedullary tumors, which constitute about half of all cord tumors, is highly satisfactory, the results being brilliant and the operative mortality about 1 per cent. Except in neglected cases, complete recovery is obtained. With the other types, operative removal and relief of cord compression may be combined with deep therapy.

SUMMARY

One should think of a tumor of the central nervous system when the signs and symptoms can be explained on the basis of a single lesion which is progressing.

The diagnosis of a tumor is established if in addition there are evidences that the lesion is space-consuming. These evidences are signs of increased intracranial pressure with brain tumors and indications of blockage of the spinal canal as shown by the Queckenstedt test with cord tumors.

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